

CITY OF AUBURN

**WETLANDS INVENTORY
METHODOLOGY REPORT**

Mill Creek Drainage Basin

Prepared: January 31, 1989

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CITY OF AUBURN

PLANNING AND COMMUNITY DEVELOPMENT DEPARTMENT

Mary McCumber, Director
Greg Fewins, Project Manager
Janie Civile, Biologist
Lizzie Zemke, Biologist
Greg Hood, Biologist

**US Department of Commerce
NOAA Coastal Services Center Library
2234 South Hobson Avenue
Charleston, SC 29405-2413**

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Greg Fewins
Project Manager

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NOTE TO READER

The purpose of this Report is to provide supplemental information related to the City's wetland inventory program. Included in the Report is a discussion of the results and methodology of the Mill Creek inventory, and an overview of wetland functions and values. Discussions concerning wetland functions have been drawn from existing research and analysis conducted by agencies and experts in the wetlands field. Most local, state, and federal agencies, and wetland experts recognize common wetland functions which comprise physical, biological and socioeconomic elements. Wetland functions discussed in this Report have been structured around these same wetland functions. The Report discusses in a general way how the character of this community's wetland areas relates to these functions. Chapters I and III describe how various wetland environments perform at different levels, providing uniquely different benefits, and how these specific functions are related to both Auburn and to this region.

INTRODUCTION

Background

For years, wetlands have been drained and filled for agricultural and building purposes. The Washington State Department of Ecology (Ecology) has estimated that over fifty percent of the State's original wetlands have been drained, dredged, or filled, and that urban freshwater wetlands continue to be lost at a rate of over 900 acres per year. Only within recent years have we begun to fully understand the values that these natural systems offer both the community and the region.

Wetlands provide a transition between land and water environments. They are lands where groundwater is usually at or near the surface, or where the land is covered by shallow water for all or part of the year. This saturation with water is the dominant factor determining the nature of soil development and the types of plants and animal communities that live within these environments. Freshwater wetlands found within the Auburn community consist of wet pasture, deep and shallow marshes, open water, scrub-shrub, and forested environments. While many are associated with open water, others are more isolated and are a result of poorly drained, saturated soil conditions. Over time, these wetlands have developed, expanded and contracted in conjunction with changing climatic, natural and artificial conditions.

Much of the undeveloped Auburn portion of the Green River valley is characterized by hydric (wet) soil conditions. These hydric soils consist primarily of alluvial deposits, with sandy stream beds transecting the valley floor. Typically, alluvial soils in low land communities are hydric due to prolonged water saturation. Water saturation is characteristic of low lying valley areas which receive runoff from surrounding hillsides, or are subject to periodic flooding. The combination of these factors encourages the growth of hydrophytic (wetland) vegetation, resulting in the formation of wetland environments. The fact that large portions of the Auburn Valley have remained undrained and fallow for a number of years has encouraged the generation and regeneration of a significant amount of wetland area within the community.

Historically, the City has addressed wetland issues through the State Environmental Policy Act Rules (SEPA) environmental review process. In conjunction with the SEPA process, the Auburn Shoreline Master Program and the Auburn Comprehensive Plan provide policies and regulations related to wetlands management. This effort has resulted in some conservation and enhancement of wetland areas, and some approvals for filling and development. However, to date, there has not been extensive pressure to develop some of the more critical wetland areas within the Auburn Mill Creek drainage basin.

Policies and regulations of the City's Shoreline Program apply to all lands extending 200 feet from the ordinary high-water mark, and all marshes, bogs, swamps, floodways, river deltas, and flood plains associated with the shoreline area. On a city-wide basis, the City's Comprehensive Plan provides both policy direction and an illustrative map of prime wetland areas. Use of Comprehensive Plan and Shoreline Management policies and regulations, in conjunction with the City's environmental review process, allows for an analysis of impacts and assessment of

mitigation measures based on the merits of a particular wetland environment. However, these existing policies and regulations do not reflect recent developments in state and federal activities, or current management practices for wetland areas.

The purpose of this Report is to provide supplemental information related to the City's wetland inventory program. The remaining portion of this chapter provides an overview of the Auburn Mill Creek wetland inventory program and methodology, and an overview of wetland functions and values. Subsequent chapters on methodology, and functions and values provide a more in-depth technical compilation of existing research as it applies to the character of this community's wetland conditions. A bibliography and references to information sources is provided.

Inventory Background

In conjunction with a grant from the Washington State Department of Ecology (Ecology), the City funded an inventory of wetlands within the Auburn community. The first phase of inventory work began in early September 1988, and was concluded on November 30, 1988. This initial wetlands inventory was conducted in the 7.3 square mile (4700 acre) Auburn Mill Creek drainage basin. Subsequent inventories will be conducted in the Auburn Green and White River drainage basins beginning in 1989 (subject to additional Ecology grant funding).

The Mill Creek inventory area includes all properties located west of Auburn Way North and "A" Street S.E., within the City of Auburn. The Mill Creek drainage basin was selected because the area is substantially undeveloped and presently under development pressure for commercial and industrial growth, other drainage basins have stronger existing regulatory controls related to wetlands management (i.e., shorelines management, forest practice permits), and to facilitate preparation of a Special Area Management Plan (SAMP) with the U.S. Army Corps of Engineers (Corps).

Preparation of the inventory involved extensive coordination with other local, state and federal agencies including King County, Washington State Department of Ecology, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and U.S. Fish and Wildlife Service (F&WS). Because of this involvement, the inventory has been received with a high level of confidence and credibility by these agencies.

The purpose of the inventory program is to identify the general location and character of Auburn's wetlands. In conjunction with various policies and regulations, the City's wetlands inventory program will assist in bringing better certainty and predictability to the environmental and development processes than presently exists. Products of the initial phase of the City's wetlands program include a mapped base of wetlands information, a field survey of wetland characteristics, this 'Wetland Report,' and proposed Comprehensive Plan policies.

Conducted on an area-wide basis, the City's inventory provides a general delineation of known wetlands based on the Corps and F&WS definitions and field methodologies. However, over time wetlands develop, expand and contract in conjunction with changing climatic, natural and artificial conditions. Therefore, future site specific wetland studies will identify the precise location, delineation and

functional characteristics of known wetland areas, and additional areas not previously inventoried.

Results

The 7.3 square mile (approximately 4700 acre) inventory area represents approximately 37% of the entire City. The first phase of inventory work mapped 59 wetlands based on the Corps and F&WS definitions and methodologies totaling 1,016 acres (see Figure 1). 686 acres (15% of the inventory area) is mapped as meeting the Corps methodology. This acreage represents approximately 25% to 35% of all vacant industrial lands in the City, approximately 6% of all commercial lands in the inventory area, and approximately 2% of all residential lands in the inventory area.

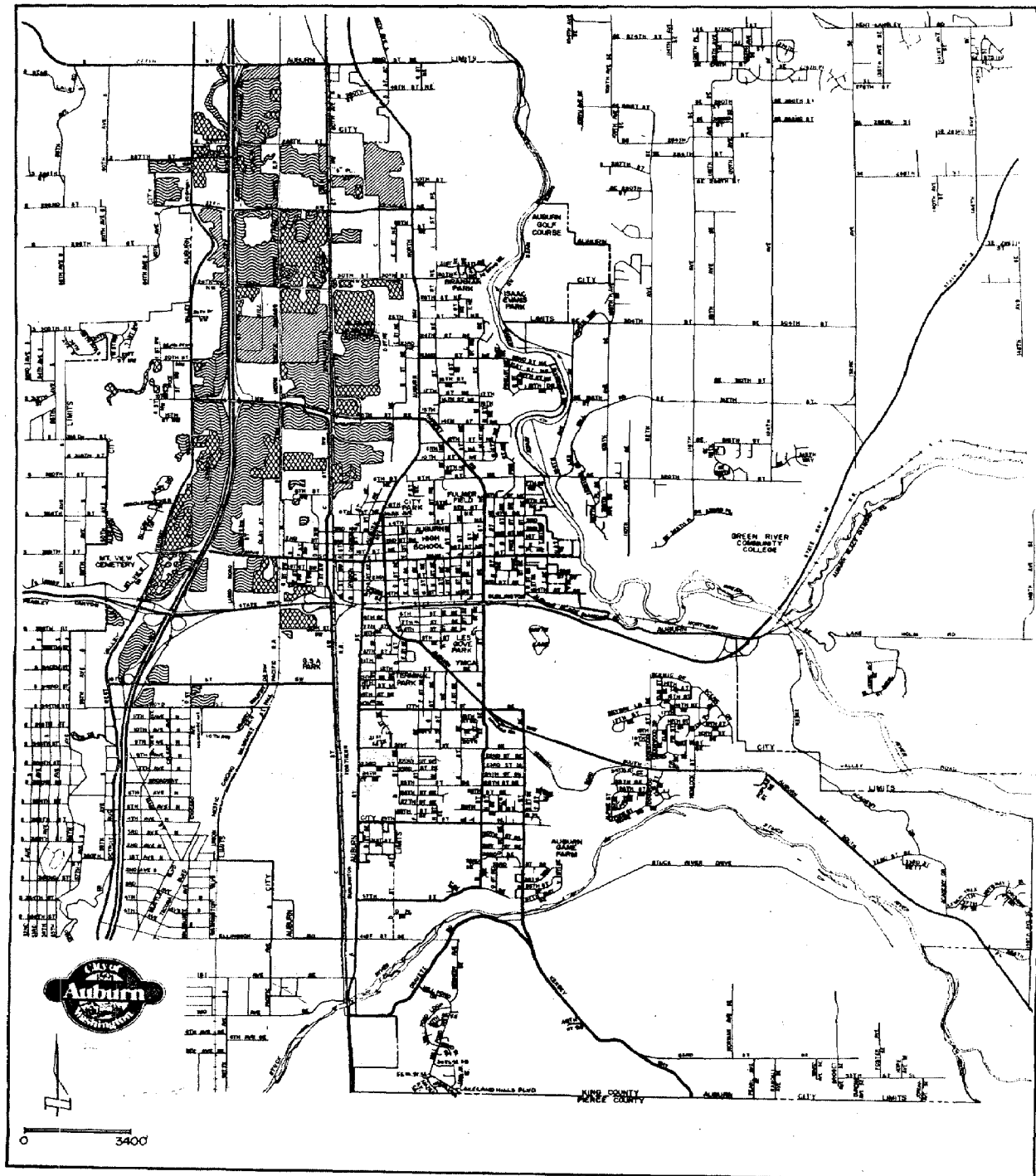
Identification of wetland areas does not mean that properties are undevelopable. In some cases, impacts from development on wetlands can be mitigated by means of buffering, enhancement or relocation of wetland areas. The inventory should serve as information to property owners, developers and the City that wetland conditions may exist. In addition, areas mapped as meeting the Corps methodology should alert property owners and developers that a Corps permit or approval may be required. It is through subsequent City and Corps permitting processes that decisions regarding development, conservation or enhancement will be made.

Process

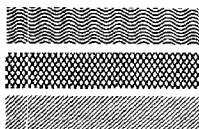
Through the inventory process, more than thirty formal meetings and countless informal meetings were held with agencies, developers, property owners, environmental groups, special interest groups, and individuals. The City developed a mailing list of nearly 600 individuals which were sent notice of all public presentations and hearings. This mailing list includes all commercial and industrial property owners in the inventory area, residential property owners where wetlands have been identified, and all interested agencies, environmental and development groups, and individuals.

Two formal open houses were conducted by City staff. On November 10, 1988, an open house was held to introduce the City's inventory program, and discuss wetland issues. A second open house was conducted on December 22, 1988, to publicly present the inventory maps, survey results, and introduce tentative policy topics. Both open houses were well attended and positively received. In addition, individuals have been encouraged to meet with City staff regarding any questions or concerns.

The next major step in the City's wetlands program will be to develop a Special Area Management Plan (SAMP) for the entire 22 square mile Mill Creek drainage basin. Discussions are now underway between the City of Auburn, City of Kent, King County, and the U.S. Army Corps of Engineers to develop a SAMP. The SAMP process will take approximately two years to complete, and will include extensive public involvement and input from property owners, developers, environmental groups, other local, state and federal agencies, and interested individuals. The purpose of the SAMP will be to establish agreement between local governments and the Corps regarding wetland areas which must be conserved, and



Legend



Corps of Engineers and
U.S. Fish and Wildlife

U.S. Fish and Wildlife

Not Inventoried

NOTE: This map provides an illustration of wetlands located only within the Auburn Mill Creek drainage basin. Subsequent wetland inventories will be initiated within the Green and White River drainage basins beginning in 1989. Prepared on an area-wide basis, the inventory map provides a general delineation of known wetlands based on the U.S. Army Corps of Engineers and U.S. Fish & Wildlife Service definitions and field methodology. Over time wetlands develop, expand and contract in conjunction with changing climatic, natural and artificial conditions. Therefore, future site specific wetland studies will identify the precise location, delineation and functional characteristics of known wetland areas, and additional wetland areas not previously inventoried.

FIGURE 1
Wetlands Inventory
City of Auburn
Mill Creek Drainage Basin

those areas which can be filled and developed. The goal of the Corps will be to issue a regional permit to the planning area to improve current permitting processes, and return a higher degree of predictability to the local governments.

Other Related Activities. Wetlands management is active not only within this region, but also across the country. Many actions have recently been taken by the federal, state and local governments to limit the loss of remaining wetland areas. In January 1987, the Corps increased its regulatory authority over wetlands within the Washington District. The Corps regulatory authority moved away from wetlands directly associated with streams and rivers, to isolated areas having no direct hydrological relationship with streams or rivers. Expansion of the Corps authority has resulted in an additional agency having regulatory control over development within the City's wetland areas.

The National Wetlands Policy Forum recently recommended that the U.S. Congress adopt a "no net loss" policy regarding wetlands. In addition to protecting the remaining wetland areas, wetland functions and wetland values, the policy suggests that additional wetland area should be developed over time.

The Puget Sound Water Quality Authority, representing the twelve county Puget Sound drainage basin, has released a series of reports related to regional water quality. The reports have dealt extensively with wetlands and have recommended such actions as potential secondary treatment of storm drainage, developing a regulatory program for wetlands management, and adopting the F&WS definition of wetlands.

The Department of Ecology is currently introducing wetland legislation for adoption in 1989. This legislation would mandate local governments to adopt a wetland management plan similar to the State's existing shorelines management program. Ecology also utilizes a "no net loss" policy regarding wetlands, and the F&WS definition of wetlands.

Locally, many communities have prepared wetlands inventories and adopted policy or regulatory programs for wetland management. Such programs have been developed in response to recent agency activities related to regulation of development within wetlands (i.e., U.S. Army Corps of Engineers Section 404 permits), in anticipation of new legislation and mandates, and in order to become more environmentally responsible in managing one of this region's limited natural resources. A key product of wetland inventories and policy or regulatory programs is the establishment of better certainty and predictability in a community's environmental and development processes.

Methodology

Wetlands within the Auburn Mill Creek drainage basin were mapped in accordance with the Corps and F&WS definition and field methodologies for wetland delineation. Both agency definitions include elements of wetland (hydrophytic) vegetation, water saturation (hydrology), and wet (hydric) soils. However, to be classified as a wetland, the Corps definition requires a positive finding of all three elements (parameters) while the F&WS definition requires only two (at least hydrology and either hydric soils or hydrophytic vegetation must be present).

In comparison, the Corps definition and methodology for identifying wetlands tends to delineate a more concise area than does the F&WS methodology. The F&WS methodology delineates a broader area, including unvegetated areas, and is used extensively for large scale inventories and surveys. Many agencies, including Ecology, utilize the F&WS definition and EPA methodology for wetlands delineation.

Several existing resources were utilized in conjunction with the field inventory. Some of these resources included aerial photographs, soils maps, flood plain/floodway maps, the F&WS National Wetlands Inventory, and other existing wetland inventories and studies. The actual field survey process included an evaluation of soil samples, an ocular survey of vegetation types, vegetation changes, evidence of hydrology, and inspection of the site for evidence of wildlife or habitat opportunities.

Because the inventory was conducted in the late summer and fall months, hydrology was the most difficult element to verify on some parcels. In cases where certain parameters were suspected but no conclusive evidence found, wetland data has been flagged to indicate that further investigation will be necessary. Areas in which vegetation had been removed or was under cultivation, but showed signs of hydric soils and hydrology, were mapped as non-inventoried. These areas will require further mapping and analysis at a later date.

In addition to mapping wetland areas, the City collected data on hydrology, soil characteristics, biological information related to wetland vegetation, wildlife and habitat opportunities, and cultural information regarding proximity to parks, schools and the types of adjacent land uses (see Appendix A, Wetland Data Form). This data will be kept on file as information related to specific parcels, and will be available to the public. Chapter II provides more detailed information and background on the City's inventory methodology.

Functions and Values

Wetlands within Auburn serve both as community resources, and as an important part of this region's overall drainage basin and wetland systems. As community resources, wetlands provide a number of local functions including storm drainage control, wildlife habitat, pollution and erosion control, ground water exchange, open space and aesthetic contrast, and recreational, educational and cultural opportunities. These community functions combine with other wetlands to form a regional system. These larger systems may range in scale from that of a drainage basin, in the case of flood control, to a national or international scale, in the case of providing habitat for migratory waterfowl.

The location of wetlands can affect the functions provided by wetland environments. Salt water marshes and estuaries provide a different function than do freshwater wetlands. Similarly, wetlands which are hydrologically associated with rivers or streams provide a different function than do isolated wetlands which have no hydrological relationship with a river or stream. Even when comparing the same type of wetland environments, they can provide significantly different levels of functions based on their size, location and characteristics. In addition, each community may place a different value on the various functions that wetlands provide. Understanding the nature of a particular wetland system, and the system's

relationship to both the community and surrounding region is critical to establishing the actual value of benefits and opportunities derived from wetland areas.

Freshwater wetlands found within Auburn consist of wet pasture, deep and shallow marshes, open water, scrub-shrub, and forested areas. While many are associated with open water, others are more isolated and are a result of poorly drained soil. Drainage from the north Auburn area flows into the Green/Duwamish River drainage basin, and eventually north into the Seattle Puget Sound area. Drainage from the south Auburn area flows into the White/Stuck River drainage basin, and eventually southwest into the Tacoma Puget Sound area. The mouth of both of these major drainage basins is highly urbanized by industrial development, and includes little or no saltwater marsh or estuary type wetlands.

From a local perspective, wetlands of the type found in Auburn provide a number of important functions. Such wetland functions range from on-site storm drainage facilities, to providing a visual contrast within an urbanized area. A summary of principal local functions provided by important wetlands are noted as follows:

- Allow localized flood waters to dissipate, reducing the height and velocity of flooding and stabilizing soils from erosion.
- Provide pollution control and improve water quality by filtering sediments, excess nutrients, and toxic chemicals.
- Provide local ground water exchange opportunities between surface and subsurface hydrological systems.
- Establish habitat area providing feeding, nesting and breeding grounds for resident fish and wildlife.
- Provide an aesthetic contrast in urbanized areas between open water and uplands.
- Create passive recreational opportunities.
- Provide unique cultural, educational and scientific research opportunities for the community.

From a regional perspective, Auburn's wetlands provide a different level of function. A summary of principal regional functions provided by wetland systems are noted as follows:

- Provide for storage of regional floodwaters and slowing of floodwater velocity.
- Provide pollution control and improve water quality by reducing the amount of sediments and toxic chemicals which may enter a drainage basin.
- Increase ground water exchange opportunities between regional surface and subsurface hydrological systems.
- Provide needed habitat for migrating fish and waterfowl.

In the broadest sense, wetlands exhibit benefits related to biological, physical and socioeconomic elements. However, specific functions within these broader elements are diverse, and are not found uniformly throughout all of the various types of wetland environments. Because of this diversity, wetland functions may vary between communities and between regions, based on specific wetland characteristics.

When viewing wetland functions from a system perspective, the City's philosophy and approach to wetlands management can have an affect on the larger region. However, by distinguishing between different wetland types, wetland functions, and community values, impacts to wetlands can be better evaluated and mitigated based on the merits and characteristics of a particular environment. Chapter III provides more detailed information and background regarding local and regional wetland functions, and how they apply to the Auburn community.

Conclusion

Completion of the Mill Creek, Green River and White River wetland inventories is a major element potentially effecting a number of programs carried out within the City. As with most all important natural systems, wetlands can affect growth, development and the arrangement of services throughout the community. To that end, it is critical that each inventory maintain a high degree of professional quality, be coordinated with affected agencies, property owners and individuals, and be based upon criteria designed to meet established community values, expectations, and environmental practices.

There are primarily two strategies for implementing the City's wetlands management program. These strategies include the adoption of policy amendments to the Auburn Comprehensive Plan, and/or adoption of new wetland regulations. Within each of these implementation strategies, there are various levels of control that can be achieved. Simply not addressing wetland issues would leave unpredictability and uncertainty in the City's environmental and development processes as now exists.

In any event, the City's Plans, policies and regulations are designed to balance various community interests. Likewise, the addition of any policies or regulations related to wetlands management must create this same balance. Because sensitive environmental areas typically affect a community's ability for growth and development, there is a strong need to balance the City's commitment to both environmental and growth related interests. The following provides a recommendation for implementation of a balanced wetlands management program through the adoption of additional Comprehensive Plan policies.

Recommendations. Existing wetland policies outlined in the 1986 Auburn Comprehensive Plan do not reflect recent developments in state and federal regulations, or current management practices for wetland areas. The Plan was adopted just prior to the expansion of the Corps regulatory authority over isolated wetlands in January 1987. Therefore, it would be appropriate to update the Comprehensive Plan to reflect these recent changes.

Comprehensive Plan policies are used extensively in conjunction with the City's SEPA environmental review process. Because development related impacts to wetlands are evaluated through the SEPA process, the addition of wetland policies would provide better direction to the community regarding the City's philosophy. In addition, policy amendments to the Plan would not change the City's existing procedures related to environmental and development processes. Impacts to wetlands would continue to be evaluated in conjunction with project development through the SEPA environmental review process, or other existing regulations such

as the City's Shoreline Master Program, when applicable. Applied citywide, as are all policies of the Plan, the amendments would preclude the need for additional regulatory controls at this time.

Over the short term, the City's adoption of Plan policy amendments would not result in an action which would conflict with the preparation of a SAMP. Completion and adoption of a SAMP will bring a more regional perspective to wetlands management, potentially requiring local implementation through adoption of additional policies, rules or regulations. Therefore, the addition of basic wetland policies to the Plan at this time would act as an interim measure while the SAMP is being developed. Upon completion of the SAMP, the City will review existing Plans, policies and regulations to determine if additional changes are necessary.

METHODOLOGY

Introduction

Attitudes towards wetlands have evolved slowly from seeing them as wastelands, to realizing their value as critical natural resources. These attitude changes have in turn lead to various regulations governing the use of wetlands. Different agencies within the federal and state governments developed their own definitions as the need arose, and there is still no single nationally accepted definition for wetlands.

Section 404 of the Clean Water Act established a regulatory definition of the "waters of the United States" which is the basis for the U.S. Army Corps of Engineers (Corps) jurisdiction over filling of wetlands. Under normal circumstances, the Corps' definition of wetlands requires a positive finding for three parameters: hydrology, hydrophytic vegetation, and hydric soils. The wetlands delineation methodology is designed to determine exactly where on any given site, the Corps' Section 404 jurisdiction begins and ends relative to wetland fill proposals. The Corps' wetland definition refers only to vegetated wetlands, and excludes tidal and mud flats, which the Corps regulates as other special aquatic sites under Section 404 of the Clean Water Act.

The U.S. Environmental Protection Agency (EPA) has advisory and review authority over the Corps' filling permits and has developed their own field methodology for delineation purposes. Although their authority comes from Section 404 of the Clean Water Act, their regulatory mandate for environmental protection comes from other legislation as well, and is not restricted to Section 404's specific language. In 1980, EPA issued interim guidance for identification and delineation of wetlands, which is the rationale for their methodology.

The U.S. Fish and Wildlife Service (F&WS), through wildlife habitat research and the compilation of a National Wetlands Inventory, developed an ecological or functional definition. This definition is supported by a fairly complex classification scheme which carries specific information about each wetland. The F&WS maps are derived from high altitude infrared aerial photographs. Information from this National Inventory comprises a National Wetlands Data Base, which can be accessed throughout the country.

The F&WS definition and the EPA's methodology differ from the Corps' in that they define ecologically functioning areas and include tidal flats, mud flats, and other unvegetated areas as wetlands. The F&WS's definition is a broader and more inclusive definition than the Corps', and is used extensively for inventories and surveys. While being similar to the Corps' in that data on hydrology, soils and vegetation characteristics are evaluated, positive findings for only two of the three parameters are required under the EPA's methodology. Wetland hydrology must be present, and presence of either hydric soils or hydrophytic vegetation on a site indicates a functioning wetland. Although the Corps, EPA, F&WS and the Soil Conservation Service (SCS) are currently working to develop a single methodology which will be used in regulatory delineations, problems exist for local and state jurisdictions in deciding which definition and methodology is appropriate to apply in mapping and regulating wetlands.

In compliance with the Washington Department of Ecology's (Ecology) Coastal Zone Management grant, Auburn's inventory mapped wetlands meeting the F&WS definition, as well as those meeting the Corps' definition. By mapping wetlands according to F&WS criteria, Auburn's inventory will be consistent with the National Data Base compiled by the F&WS, and can be used in national trends studies. Mapping Corps-defined wetlands will provide regulatory information to property owners in Auburn, and serve as a data base for the cooperative Special Area Management Permit (SAMP) process. The Puget Sound Water Quality Authority and other state agencies have adopted the use of F&WS's definition, and should any expansion of the Corps' methodology occur, these wetland areas will already be mapped. Since F&WS wetlands tend to be larger than Corps wetlands, the maps will provide valuable information on possible mitigation sites, and approximate direction of water movement. If these F&WS extensions of Corps areas are filled, it is possible that additional water will move onto the Corps-defined sites. Mapped information on wetter and drier property will also help stormwater utility planning by Auburn's Public Works Department.

Parameters Defined

As explained above, both methodologies utilize three parameters to separate a wetland from surrounding uplands. These are: wetland hydrology, presence of hydric soils, and presence of hydrophytic vegetation.

Parameter 1: Wetland Hydrology. Wetland hydrology simply means the presence of water on a particular site for a significant portion of the growing season. Soils must be inundated or saturated for a sufficient length of time to develop hydric soils and hydrophytic vegetation. A rule of thumb used in the field is saturation to within 12" of the soil surface for at least one week during the growing season. The growing season is defined by the U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) as that period of time when the ground is above "biological zero," or five degrees centigrade. In the Auburn valley, the growing season extends at least from February to November.

This is the most critical parameter for wetlands delineation, and is often the most difficult to establish. The onset of the growing season varies from region to region, and collaboration with various agencies such as Agricultural Extension offices is essential to determine the appropriate time to examine each site, if no positive field evidence can be found.

The Corps and EPA use similar methods to determine the presence of this parameter, and look at hydrology during the same time periods. Field evidence of inundation or soil saturation at the appropriate time, and historical records are considered to be positive indicators of wetland hydrology. The amount of time water is on a site determines the extent to which the other two parameters will be present. Water causes formation of hydric soils, and the types of plants which can survive in flooded conditions are limited.

Parameter 2: Hydric Soils. Hydric soils are defined by the SCS as soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation. Hydric soils may be either organic or mineral in origin. Organic soils,

which contain high levels of peat, are formed in bogs at the rate of about 1" per 100 years. Mineral soils are often formed from stream depositions, or sediments dropping out of flood waters.

When a soil is flooded or saturated, water fills the air spaces in the soil, and drives the air out, which reduces the amount of oxygen in the soil. The lack of oxygen causes changes in the iron and manganese in the soil, and characteristic colors develop which can be identified using a Soil Color Chart. A soil sample is compared to paint chips whose color can indicate the degree to which oxygen has been removed from the soil. The Corps, EPA and F&WS use the same color indicators to define when a soil is considered hydric.

Bright orange mottles or splotches in the soil column indicate a fluctuating water table, and the presence of gleying is also an indication of flooding. Gleyed soils in Auburn are bluish-grey in color, and most have a sticky, clay-like texture. This particular color change is found in mineral soils, and must be within the plant root zone to indicate the presence of a hydric soil.

Parameter 3: Hydrophytic Vegetation. Hydrophytic vegetation consists of plants which are typically adapted to life in saturated, low oxygen or anaerobic, conditions. All plant roots require oxygen in order to carry out cell division and growth, and to take up water for the above-ground stems and leaves. Hydrophytic and aquatic plants are capable of carrying out these tasks in flooded (low oxygen) conditions, and get oxygen either through structural changes in their roots which make oxygen from the surface available to them, or through internal chemical processes which allow them to function in low oxygen environments. Hydrophytic plants are capable of not only existing in these conditions, but maturing and successfully reproducing in them.

The Corps, EPA and F&WS require a predominance of hydrophytic vegetation to be present on a site for a positive finding of this parameter. The F&WS produces the National List of Plant Species That Occur in Wetlands, which gives the likelihood of a plant being found in a wetland. This probability is reflected by an indicator, which is specific to geographical regions. The indicator categories range from "Obligate Wetland," a plant almost always occurring in saturated conditions, to "Obligate Upland," a plant which rarely occurs in wetlands, and is killed by exposure to flooding conditions for extensive amounts of time. The "Facultative" indicator implies a plant found in wetlands, but not restricted to wetlands, and is divided into three subcategories. All agencies working with wetland delineations refer to this same list of plants. The list is periodically reviewed and updated by wetland specialists in federal, state, and academic organizations.

The five basic indicator categories, abbreviations and the respective probabilities of a plant's occurring in a wetland are:

Obligate Wetland	OBL	>99%
Facultative Wet (+/-)	FACW	67% - 99%
Facultative (+/-)	FAC	34% - 66%
Facultative Upland (+/-)	FACU	67% - 99%
Obligate Upland	UPL	<1%

Pluses and minuses may be added to each category to indicate those plants that may be at either end of the range of that category. A plant that occurs throughout the country could have a different indicator status in each of the nine geographic regions.

Although all of the agencies who administer programs involving wetland delineations refer to the same list, they do not all interpret the list in the same manner. The Corps defines hydrophytic plants as those with an indicator of Facultative or wetter, excluding FAC-, FACU and UPL plants. The F&WS and EPA include plants down to FACU- that may be functioning as hydrophytes in saturated conditions and hydric soils. The F&WS and EPA methodologies expand the list of possible hydrophytes, and in some cases can expand the areas delineated as wetlands considerably.

Within an agency, different districts may view the list as a guideline and a flexible tool, while other districts may use the list as a literal and fixed reference not open to interpretation. The constant revisions and updating of the list, while necessary to maintain current information, require that changes to the list be accepted and can add confusion as to the exact status of any one species. The determination of the presence of hydrophytic vegetation proved to be the area where the greatest differences existed between the Corps and F&WS delineations.

When the final delineations were mapped, many of the Corps wetlands had a fringe, or extension of area that would be included under the F&WS method. Some wetlands were the same size using both definitions, but were mapped as Corps with the understanding that if an area qualified under the Corps' definition and methodology, then it also met F&WS's requirements.

Inventory Planning Process

Inventory Crew. Three wetland biologists were hired to conduct the field survey as employees of the City through the Environmental Internship Program (EIP). The EIP program provides temporary specialists to agencies and firms for projects requiring scientific or environmental expertise. Recommendations for inventory personnel were also provided to EIP by Ecology. The crew included biologists with extensive botanical backgrounds in plant identification, particularly grasses. In addition, team members had knowledge of soils, hydrology, surveying, and wildlife habitat analysis. These individual skills were enhanced through an intensive training session developed by Ecology on wetland delineation and field methodologies.

In August, personnel from Ecology's Wetlands Section of the Shorelands Division conducted a three day training session for the inventory team that would be doing the field delineations. Ecology arranged for a representative of the F&WS regional office in Portland to present a workshop on the Cowardin System of Wetlands Classification, and staff from the Corps attended the session as well. Participants dug soil pits, examined soil colors, mottling, gleying, and discussed problems likely to be encountered when applying methodology, and where the two methodologies might differ. Three sites which were fairly representative of the inventory area's vacant land were visited, two which were not disturbed, and one which had been partially filled. Both Ecology and Corps personnel were available for advice throughout the inventory, and return visits for site inspections and data sheet reviews were made by both agencies.

Existing Sources. A number of different sources were consulted initially for information that had already been compiled and might affect the delineation of wet areas. The information came from various agencies, as well as Auburn's Public Works and Planning departments.

Blue Line Section Maps. Section maps of the city, which were transferred to mylar sheets, were available to the inventory team. Blue line prints made from the mylars were the working maps for the inventory. Each wetland was drawn on the appropriate blue line(s), as either Corps or F&WS. The wetlands were numbered chronologically, and according to their proximity to Mill Creek. Those directly associated with the creek had the prefix 1. attached to their number to identify which wetlands were associated with Mill Creek.

Aerial Photographs. In addition to the blue lines, 1":200' scale black and white photos of quarter sections were available to the inventory team. Although the black and white film does not have as much information on vegetation as high altitude infrared film, the greater detail was extremely helpful, and the photos were the size of the regular section maps. Infrared photos are more expensive to produce, and are usually printed on 1'x1' sheets. The black and white photos were on a 3'x3' sheet, and vegetation patterns were easy to see.

SCS Maps. Much of the Green River valley is mapped as hydric or urban (fill) soil. The soils consist primarily of alluvial deposits, with sandy streams threaded throughout. The 1973 King County Soil Survey maps were used to determine the approximate location of different soil types. The soil information was then transferred to the blue line section maps. Although the SCS map scale is much larger (1":24,000') than the section maps (1":200'), the boundaries were used as guidelines, and many of the soil pit samples agreed with the soil descriptions and locations given on the SCS maps.

Federal Emergency Management Agency (FEMA). FEMA has developed maps showing floodplains and floodways which are used to determine flood insurance rates. Development within floodways and floodplains is restricted, and insurance cannot be obtained for buildings that violate these restrictions. These maps were used by the inventory team to help identify which areas adjacent to Mill Creek were likely to experience sufficient flooding to produce a positive finding for the hydrology parameter.

F&WS National Wetlands Inventory Maps. These national inventory maps are produced by the F&WS to show wetland locations. Wetlands are delineated through the use of high altitude infrared aerial photography, in conjunction with the Cowardin classification system. Although these maps are excellent starting points for a local inventory, they are produced at such a large scale (1":24,000') that the detail required for parcel specific work is not provided. F&WS provided the latest draft version of the Auburn quadrangle map, dated August, 1988, for the inventory team's use.

Storm Drainage Maps. The storm drainage maps produced by Auburn's Public Works department were used to locate drainage pipes and ditches which might affect the hydrology in a wetland.

Data Sheet Development. Because of the scale of the inventory, the intensive methodologies for Corps and EPA delineations were not possible to follow. Each requires that transect lines be established, and numerous plots sampled. After reviewing the shorter delineation methods of each, a composite was developed which added greater detail to the Corps' "routine" method, and decreased the amount of computation required by the EPA's "simple" method. This composite method was discussed with Ecology and the Seattle District Corps, to assure that all delineation requirements would be met.

The data sheets used by the inventory team in the field were designed to be compatible with a spreadsheet program. Multiple choice questions were used to format needed information, with spaces included for comments and notes. (See Appendix A.) Ideas for questions came from Corps, F&WS, Ecology, King County and City of Bellevue data collection sheets, and from the specific needs of the City of Auburn.

The completed data sheets were nine pages long, with additional pages added for more complex plant communities. The data collected on each site included observations on hydrology, soils, vegetation, biological factors such as presence of wildlife and habitat opportunities, cultural values, and proximity of the wetland to city parks, trails, schools and urban development. In addition to the data sheet, field notes were taken on a daily basis, and a copy of these notes are on file with the data sheets.

Delineation Procedure

Wetland Hydrology. Field determination of the presence of wetland hydrology requires documentation of positive signs of soil saturation during the growing season, a process which is the same for any methodology. Evidence of water marks, floodlines, debris deposited from flooding and other field indicators were searched for, and filling of soil pits by water was noted.

Hydric Soils. In order to assess the character of the soils on any given site, soil pits were dug, and the colors and characteristics of the soil documented. Mottling in the soil column was looked for, as was gleying. Mottling was usually orange in color, although some soils produce light tan or black mottles. Gleying, development of a bluish-grey color, was usually found in a layer which had a clay-like texture. Mottling was often found in gley layers, as well.

After the presence of mottling or gleying was established, a sample of soil taken from at least 10" below the surface was soaked with water, then compared with paint chips in a Munsell Soil Color Chart. These chips are organized according to the amount of blue, yellow or red in a color, then according to the amount of grey or white in a color.

Soils within a series fall within a certain range of colors, and those in the inventory area were usually a dark brown, with more yellow than red in the brown. The greyer the soil color is, the less oxygen is present. A value of 2 for chroma (large amount of grey), with mottling present in the soil, indicated a hydric soil. Soils lacking mottling, but with chromas of 1 (very grey) are also considered to be hydric.

Soil pits were dug at obvious points of change in vegetation types, (i.e. from pasture grasses to sedges and reed-like plants), or where vegetation associations become dominated by a different Indicator status. The soil pits were critical in determining the edges of the wetlands, and in deciding whether a specific community would be included in the delineated wetland. When the vegetation began to change to a "drier" condition, a soil pit would often indicate that the soil was no longer hydric.

Hydrophytic Vegetation. When the inventory team reached a site, the primary task was to walk the entire site, keeping a list of species, and estimations of coverage for each species found on the site. As plant communities and associations changed, new percentages for each species were recorded. Each site was walked by a minimum of two team members, and most of the inventory area was covered by all three.

By process of discussion, the different vegetation units or communities were established, and a complete list of species seen in each community was compiled with percent areal cover for each species. When estimating areal coverage, the object is to quantify the amount of ground a plant shades or covers. Thus, if plant communities have several canopy layers, or smaller plants are intertwined with larger, the percentage totals can and usually do exceed 100%. Vegetation changes, from communities largely comprised of hydrophytic plants to larger numbers of upland plants, were usually the easiest and most obvious indication that the conditions on a site had changed from wetland to upland.

Habitat Information. Observations were made at each site to determine the value of each wetland to wildlife. Habitat includes everything a creature requires or utilizes for its existence and/or well being. Animals require, at least to some extent, food, water, breeding and nesting sites, protection from predators, and shelter from the weather. Virtually any open space can provide habitat for some type of bird or animal, but certain characteristics combine to provide higher quality habitats to larger numbers of wildlife species.

The type of vegetation on a site determines to a great extent the amount and type of food that is available. Berries, fruit, and grains are obvious supplies of food, as well as mixtures of grasses, shrubs and herbs for birds that eat seeds or animals that graze on foliage. Shrubs and trees provide cover for nesting and perching birds, and protection for smaller animals from predators. A site with a variety of vegetation types will support more types of wildlife than one with a single, or monotypic composition. A variety of vegetation types will also provide more shelter from weather extremes. The presence of shelter, protection and food not only tends to increase the number of smaller birds and animals on a site, but also increases the number of predators due to an increased prey base.

The overall condition and age of the vegetation influences the benefits provided. A young stand of alders may provide some shelter and food, while an older stand would provide more nesting sites but not as much food. A snag would no longer provide food, but might have cavity-nesting birds such as woodpeckers or owls. Likewise, a mowed meadow provides grazing and loafing opportunities for waterfowl, but an unmowed meadow provides much more shelter and nesting sites for rodents and other birds.

Presence of water bodies provides food and habitat for fish and predators, such as blue heron who depend on aquatic animals for food. All animals require water for metabolic processes, although the presence of open water tends to increase the numbers of some species, and decrease others. Many animals such as waterfowl, beavers, muskrats escape predators by taking to the water and diving for long periods of time. The condition of the water body, whether or not it is subject to polluted runoff water from dairy operations or industrial sources, and the amount of algae and other plants growing in it, whether it is ponded or free flowing, will affect the type of animal supported.

The actual physical shape or contour of the land surface can affect the types of wildlife found on any site. Open, flat sites are better for flocking waterfowl, as well as predators such as Northern Harriers who cruise over open fields looking for field mice. The size of a particular site can determine the value of that site to wildlife. Larger sites tend to have a wider variety of habitats available to animals, and may provide more types of food, thereby increasing the variety of animals found on the site.

Inconclusive Areas. Since the inventory was begun in August, after an unusually dry two-year period, many of the sites visited in the beginning of the study were extremely dry. Hydrology is very difficult to positively determine in August and September due to seasonal fluctuations. Soon after the prolonged summer drought, Auburn began receiving significant amounts of rain, which is usual for the fall in the Pacific Northwest. Many sites, because of impermeability of summer dried soils were suddenly flooded with inches of rain and runoff water. Because of this drastic fluctuation, some sites were nearly impossible to designate as possessing positive hydrology. Because of this circumstance, the inventory team recommended that an area with reasonable indications of meeting the other two parameters be checked during the appropriate time of year for positive signs of hydrology. These areas were included on the final maps, as either F&WS or Corps, depending on which criteria they appeared to meet, but will be removed should they fail to meet the hydrology parameter.

Non-Inventoried Areas. Certain areas within Auburn have been cultivated and in agricultural use for a considerable amount of time. The presence of hydric soils, and indications of wetlands hydrology on some of these sites suggest that if cultivation was discontinued, these areas might revert to hydrophytic vegetation. If so, they could be considered wetlands under the Corps' special circumstances conditions. Such areas were mapped as non-inventoried to identify that future site specific studies would be required.

Final Mapping. After each blue line Section map was completely inventoried, the blue line was digitized by an Engineering Technician. Information on each wetland boundary was incorporated into the City's GIS (Geographic Information System) computer mapping program, and was plotted with an overlay of property lines. At the end of the inventory, the sections comprising the study area were merged into a composite map which can be plotted at various scale levels.

FUNCTIONS AND VALUES OF WETLANDS

Introduction

Wetlands are known to perform many functions which have intrinsic value and ecological benefit. Among these functions are controlling flood and stormwater, filtering sediments from rivers and streams, and allowing exchange of ground and surface water supplies. Wetlands are the base of vast food chains which support fish and wildlife, and provide opportunities for recreation, education and research. These functions often may not be what people would consider to be of economic or monetary value to themselves. But in the long run, they contribute to storm and floodwater management, are critical components of Washington's fishing industries, and help to maintain overall water quality. Wetlands are of benefit to a community, and can reduce costs of water treatment, flood control structures, and the maintenance required for upkeep of these facilities.

Similar types of wetlands may vary in function and value because of their size, or their location. A large and diverse wetland can provide more habitat for wildlife than a smaller or monotypic site, although smaller wetlands might be performing functions that are all the more valuable if habitat for wildlife continues to disappear. Wetlands associated with open water may provide a greater degree of flood control or more recreational opportunities than those which are isolated from rivers and streams. Introduction of pollutants into a wetland can lessen a wetland's ability to benefit both wildlife and the local community. How a particular wetland is functioning and the values it provides ultimately depends on its relative position in a drainage basin, and the basin's overall relationship to a community. In other words, to understand the value of a particular wetland, it is important to assess the entire system's operation, and the part each wetland plays in that system.

This chapter discusses the diverse functions and values that wetlands provide to both the Puget Sound region and the Auburn community. Individual sections are organized to discuss regional functions of wetlands first, followed by the role Auburn's wetlands may have in these functions.

Flood Reduction

Wetlands directly reduce losses related to flooding by providing temporary storage of floodwaters and slowing floodwater velocity. They act as buffers between open water and upland areas by absorbing energy contained in flood peaks. When rivers and streams are buffered by wetlands, peak events in floods tend to be less extreme, and the soil binding action of the vegetation's roots decreases erosion of river and stream banks. Filling and replacing wetland areas tends to have the opposite effect: velocity of floodwater and runoff from impermeable surfaces increases, resulting in greater erosion and property damage. Slowing the velocity of floodwater allows sediments carried in the water to fall out, which reduces its scouring capabilities. Losses from flooding can be substantial, including road and bridge washouts, residential damage, landscape destruction, and cost of emergency response crews. As flood damage risks rise, higher flood insurance rates are put into effect. These rate increases are incurred whether the property has experienced flood damage directly, or is simply at risk due to reduced flood storage capacity and increased runoff on sites miles upstream.

Data cited in the City of Bellevue's 1976 Drainage Master Plan indicate that the cost of constructing and maintaining artificial structural controls for flood and stormwaters is substantially greater than that of utilizing natural systems¹. The cost comparison analysis provided in the Plan is site specific, however, this basic assumption underlies the direction currently taken by Bellevue's stormwater utility². Other studies indicate that watersheds whose wetlands have been filled or destroyed experience up to 80% more flood events than similar basins whose wetlands are intact³. Although flooding in the Green and White rivers does not present a significant problem for Auburn due to extensive diking along the river channel, Mill Creek does flood on a regular basis. The wetlands situated along the creek corridor retain and filter the water from these flood events.

Water Quality Improvement

One of the most important contributions wetlands make to both regional and local communities is that of water quality improvement. Much of this function relates to a wetland's ability to serve as a natural filtration system, of both sediments and nutrients carried by rivers and streams. When water enters a wetland, the physical barrier of the plants slows the water and may stop it entirely. Sediments carried in suspension in the water are deposited and tend to stay in place unless the water velocity increases again. This deposition of sediments provides nutrients needed by plants, while filtering the water at the same time.

The length of time the water is in the wetland determines how much sediment filtration will occur. Gradual removal of sediments as rivers flow through wetlands benefits the estuaries and bays that these rivers eventually empty into. Certain levels of sediments in a river provide nutrients for estuarine organisms, and estuaries themselves develop from the deposition of sediments. However, a heavy load of sediments, especially from polluted urban areas, can destroy the shellfish and finfish communities that thrive in estuaries and are critical to Puget Sound's fishing industries. Sediments carried in the water can clog the gills of mature fish, causing suffocation and death. Sediment loading of bays and estuaries is increased by grading and filling activities in communities like Auburn which are situated miles upstream from the actual deposition.

The presence of high levels of particulate matter has several physical effects on the quality of water in a river system. The amount of light that penetrates through the water, and the depth of light penetration is greatly diminished by particulates. This attenuation of light can kill organisms that require light, significantly decreasing the plant and animal communities that normally thrive on a river's bed. Particulates tend to raise the temperature in a river, because they absorb whatever sunlight hits the river's surface, and release the light as heat. A slight temperature raise can change the kinds of fish living in a river. Many game fish, such as trout, steelhead, and salmon, require cold, clear, highly oxygenated

- 1 City of Bellevue, Drainage Master Plan. 1976. Storm and Surface Water Utility.
- 2 Watson, R. Stormwater Engineer, City of Bellevue, Storm and Surface Water Utility. Personal communication, January 26, 1989.
- 3 1988 Washington Wetlands Study Report, Washington Department of Ecology, November, 1988.

water, and cannot tolerate a warmer, opaque, low oxygen habitat. Other species which are generally considered to be less desirable to sportsmen and commercial fishing industries will replace these more valuable species as the water quality is degraded.

Another water quality function performed by wetlands is their ability to convert nitrates from agricultural fertilizers into atmospheric nitrogen. The anaerobic conditions in wetland soils are an ideal place for incoming nitrates to react with bacteria associated with plant roots, resulting in a gas which diffuses into the atmosphere. Plants use nitrogen to make protein, which, in turn is eaten by grazing animals, and converted to muscle. Agricultural input of nitrates into the ecosystem are far in excess of the natural cycle's ability to remove them, causing significant pollution of surrounding waters. The costs of replacing these natural filtration systems is unknown, and whether replacement is technically feasible has not been determined.

This ability of wetlands to filter sediments is being incorporated into many stormwater drainage plans. Although floodwater storage and sediment filtering are major functions of wetlands, a stormwater management plan must encompass more than a naturally occurring wetland. The direct diversion of runoff water from parking lots, industrial sites and agricultural areas can introduce high levels of oil, antifreeze, solvents, cement and particulate contaminants, as well as intolerable levels of nutrients from manure. The uncontrolled and unfiltered input of these types of pollutants can destroy a wetland, leaving a rotting and decaying area that may be difficult to clean up.

This problem is addressed by most stormwater utilities, but specific data on contaminant levels that can be safely handled by a natural system are lacking. PSWQA's 1989 Water Quality and Management Plan requires that all cities and counties develop plans for stormwater controls and systems. In response to this requirement, King County's Parks, Planning and Resources Department is conducting research on retention of stormwaters in wetlands. The study is in its second year, and currently has funding to monitor twenty wetlands receiving stormwater for five more years. Interim guidelines for stormwater plans will be produced by 1990, and will provide minimum standards for local stormwater plans. In the long term, it is hoped that this study will provide the definitive data necessary to answer specific questions on Northwest wetlands' tolerance for contaminants⁴.

Locally, wetlands in Auburn exhibit many of these water quality functions. As a result, this community's wetlands contribute to water quality in the Green and White rivers, and in Puget Sound. Nutrient and sediment loading, stormwater effluents and parking lot runoff waters from Auburn's industrial, commercial, residential and agricultural practices can affect downstream water quality adversely. Examples of stormwater retention ponds in Auburn can be seen at the junction east of Highway 167, and north and south of 15th SW Street. These ponds were constructed in 1984, and are now quality wetlands with cattails, rushes, sedges, and other native hydrophytic plants.

⁴ Stockdale, E. 1989. Resource Planner, King County Parks, Planning and Resource Department. Personal communication, January, 1989.

Groundwater Exchange

Wetlands, by definition, are places where the water table is close enough to the surface to interact significantly with vegetation and soils on a regular basis. This interaction varies from saturated soils to inundation, flooding and permanent surface ponding of water. Because of the close proximity of groundwater to the surface, wetlands are points where exchange between surface and groundwater takes place. Recharging of aquifers has been regarded as one of the primary functions of wetlands, and is one of the most crucial parts in the water cycle.

In the Puget Sound drainage basin, the abundance of available water near the surface is taken for granted by many people. On the eastern side of the Cascade Mountains, however, regular recharging of groundwater supplies for irrigation, drinking water, and replenishment of streams and lakes is of great concern. As water is removed from an aquifer for a community's use, it must be replaced. This is usually accomplished by percolation of rainfall and snowmelt through the soil. For many years, it was believed that water moved only from a wetland down into an aquifer. More recent hydrological studies indicate that an actual exchange between surface and groundwaters may take place.

A local aspect of ground and surface water interaction is maintenance of flow levels and temperatures in streams such as Mill Creek. The gradual release of water stored in wetlands into streams helps assure normal flows and cooler temperatures in small streams that might otherwise warm and dry up during summer droughts. Removing or lessening the storage capacity of a wetland associated with smaller streams changes hydrological patterns which insure flow levels necessary for all aquatic life in the streams. Salmon and other fish spawn throughout the year, and require water levels sufficient to support migration and spawning. Water levels are crucial to the survival of the newly hatched fish as well, and a lost run can take years to recover.

Fisheries

As discussed above, wetlands and estuaries serve as spawning and nursery sites for finfish and shellfish in the Puget Sound area. The commercial fishing industry is important in the Puget Sound region, and in 1986 well over \$202 million (retail value) in finfish and shellfish was brought in⁵. Sport catch values were placed at \$102 million in a WDF 1986 fisheries statistics report⁶. Besides providing the actual physical site for spawning and nurseries, estuaries produce the microscopic plants and animals which are the base of the food chain supporting these industries.

The freshwater wetlands associated with rivers feeding the estuaries contribute directly to the water quality and successful reproduction of salmon and steelhead. These fish require clear, clean water for spawning, and may reside for one to three years in the streams where they were spawned. Once they have reached the fingerling stage, they migrate downstream, where they mature further in saltwater estuaries. As they migrate they undergo physiological changes which allow them to live in a saltwater environment. This process requires a specific amount of

5 PSWQA. 1988. State of the Sound 1988 Report.

6 Ward, W.D. in State of the Sound 1988 Report, PSWQA. May 1988.

time, and an increase in velocity of a river through channelization and filling, can lead to significant fish kill if the smolt are not ready to survive in the saltwater yet.

According to WDF's stream index values, Coho salmon spawn in Peasley Canyon, Mill Creek's headwaters, producing up to 10,000 smolt yearly⁷. These smolt reside in Mill Creek for one year before migrating to saltwater estuaries and open ocean. Chinook, coho and chum salmon and steelhead are among the anadromous fish which spawn in the Green River or are produced in hatcheries located on the Green River. Over 10 million wild and hatchery juvenile fish live to migrate downstream, and depend on adequate water quality in the Green River to survive⁸.

Shellfish live in estuarine sediments, and because they feed by direct filtering of these sediments, they are far more sensitive to toxics and pollutants in their beds. Metals and other toxic substances found in sediments accumulates in their tissues and can lead to the eventual closing of many commercial beds that receive urban runoff. In addition to toxicity problems, substantial increases in the amount of any sediments deposited in the estuaries can smother and suffocate shellfish, destroying commercially and ecologically critical communities. The Green and White rivers drain into heavily industrialized ports, and do not affect shellfish beds directly. Pollution levels in Elliott and Commencement bays, however, can and do affect the rest of the Sound.

Wildlife

Some of the most valuable functions that wetlands perform in an ecological sense are those related to wildlife habitat. Migrating shorebirds and waterfowl use these areas for resting and feeding on yearly journeys that may encompass both northern and southern hemispheres. The mere presence of open space for resting is insufficient for these birds' needs; protection from predators, abundant food supplies, and remoteness from human activities are essential for their successful migration and breeding.

Puget Sound's freshwater wetlands and estuaries, whose production of detritus, phytoplankton, and insects has been impaired through pollution and degradation, directly affect the survival rate of millions of birds. Thousands of migrating waterfowl were observed along the Mill Creek corridor during the inventory in the fall of 1988. Draining a site drastically alters the vegetation, and changes the interaction between soil and water which are responsible for driving the high food production rates, resulting in degradation of the site for wildlife use. Filling and destruction of any wetland, of course, completely removes any site from an already limited resource.

Besides migrating waterfowl and shorebirds, many local species depend upon wetlands for food, shelter, breeding and nesting sites, and water. Great Blue Heron, familiar to many people, require the presence of frogs, snakes and small fish for their diet. These "solitary fishermen" nest in trees near wetlands, and can be seen

7 Kimbel, M. 1989. Washington Department of Fisheries. Personal communication, January 26, 1989.

8 Bradley, M. 1989. Muckleshoot Tribe Fisheries. Personal communication, January 26, 1989.

hunting in local streams and marshes. A heron nesting site ("heronry") is located within the Auburn City limits, and provides a vital location for these birds to congregate during the breeding season. Northern Harriers (Marsh Hawks) are another species which are associated with wetlands and can be seen working the fields along Highway 167. Marsh Wrens require cattails and other marsh vegetation for nest materials and food. Mammals live in wetlands who require lodging, food and predator evasion. Poor water quality and decreasing amounts of available food can affect the survival rates of mammals such as river otters, muskrats, and beaver, as much as complete destruction of a wetland by filling.

The presence of open water provides a place for nonwetland species to come for drinking water, something that all animals require. The continual depletion and removal of these natural watering holes places a physiological stress on these animals which is compounded when they are forced to travel extensive distances between food and water sources.

Recreation

For many people, marshes and estuaries provide scenic opportunities that are rapidly decreasing due to urbanization of the Puget Sound region. There is a genuine enjoyment in seeing open water and flocks of waterfowl or shorebirds along highway corridors, and many people would rank the natural beauty of the coasts and estuaries as a valuable resource. Open space in cities provides visual relief from urbanized areas, an idea that many communities are beginning to take into consideration when laying out new residential, commercial, and industrial areas. The recreational possibilities for wetlands include nature trails, observation points, canoeing, boating, fishing, and hunting. Many hunters comprise a group of avid "birders," who belong to groups such as the Duck Stamp Committee and Ducks Unlimited. These groups raise funds to create new wetlands habitats in Washington. Participation in organizations like the Audubon Society provide recreation opportunities to many citizens in the Puget Sound region.

The Interurban Bike Trail is adjacent to many of Auburn's wetlands, and provides visual access to bicyclists and strollers on the trail. During the inventory, people of all ages were seen on the trail. Since parking near the trail is readily available, senior citizens can enjoy bird watching and serenity as easily as younger persons. Interpretive signs have been developed by the local chapter of the Audubon Society at the Blue Heron Pond, near the junction of Highway 18 and the West Valley Highway.

Education and Research

There are many educational uses of wetlands, and these can be accessible to virtually any age group. Much of the ecological research that is being conducted in Washington at the university level is being done in Puget Sound wetlands. Wetlands are integrated ecosystems which present opportunities to study the interactions of land and water interfaces. The variety of animals and plants found in wetlands create a community whose complexity is often not matched in upland-based systems. This primary research provides data and information which is translated into usable products by many applied sciences, such as agriculture.

The proximity of schools to Auburn's wetlands provides an outdoor laboratory for junior high, high school, and community college science classes. The chance to observe a functioning ecosystem, and conduct water quality tests in chemistry labs while using samples that were collected by the students near their neighborhoods, brings obscure concepts into focus. For elementary school students, collecting tadpoles, studying birds, and learning about nature is fun, and teachers realize the value of bringing the local environment into their classrooms. Nearby wetlands provide the opportunity for a short excursion without planning a field trip to a remote site. Many of Auburn's wetlands are within .5 to 1.5 miles of either secondary or elementary schools.

Historical and Cultural

Historically, wetlands have played an important part in the native cultures of the Northwest. Important native archaeological sites are located in and near rivers, and the loss of these sites is irreparable. Wetlands are the home of animals, birds and spirits that are the basis of tribal rituals that embody man's knowledge of the natural world. The interdependency of the surrounding natural world and man is an ancient philosophy whose ideas are reflected in current ecological theory.

The arrival of settlers in the last century began a process of clearing and filling wetlands to build cities and establish commerce. Despite this loss, these early settlers were dependent upon the products of wetlands for survival. This cultural heritage is important today for residents of Puget Sound's metropolitan areas. Many families enjoy boating, fishing and harvesting shellfish, and maintaining these resources and the clean water necessary to support them has become a priority for many communities.

Summary

Wetlands are products of complex ecological interactions whose functions provide many direct benefits to the Puget Sound region. These valuable resources contribute to improved water quality by acting as natural filtration systems for sediments and waste products, controlling flood peaks and moderating water temperature in rivers. Physical and biological functions are combined into one of the most productive ecosystems on earth, and support the commercial and recreational harvesting of shellfish, finfish and vast flocks of migratory birds. Wetland sites are also valuable ecological laboratories for education and research, and these qualities provide opportunities for many recreational uses.

Auburn's wetlands provide storage for floodwaters and stormwater runoff, thereby reducing downriver flood peaks and decreasing water pollution in the Green and White rivers. The water holding capacity and groundwater exchange taking place in these wetlands helps to maintain water levels and moderate temperatures in Mill Creek, which increases the chance for survival for salmon smolts and other aquatic life in the creek. Investments in hatcheries on the Green and White rivers, and the subsequent salmon and steelhead runs in those rivers, are dependent upon continuing water quality and the surrounding wetlands for aquatic insects, detritus, and other food. Stormwater retention in Auburn wetlands can filter and contain runoff from agricultural, industrial, commercial and residential areas, again adding to improved water quality.

The Mill Creek corridor provides resting and feeding sites for thousands of migratory waterfowl in the spring and fall. These birds require open expanses of marsh or wetland areas during long migratory flights, and loss of these areas can impact the survival of other wildlife, as well. Breeding habitat for local birds and animals is greatly diminished by the loss of wetlands. Passive recreational opportunities in Auburn, especially in conjunction with the Interurban Bike Trail, are enhanced by the presence of wetlands for birdwatching and solitude for all ages, from seniors to scouting groups. Auburn's schools can take advantage of the proximity of wetlands for field trips and other ecological studies. Wetlands within the Mill Creek inventory area are an integral part of one of Puget Sound's many drainage basins, and as such, contribute to the overall quality of the Sound, and the quality of life around it.

GLOSSARY

Areal Cover	An estimate of the area covered by the foliage of a plant species projected onto the ground. Each species is considered separately from other species, and because of foliage overlap, the total areal cover for all species will often exceed 100%.
Aerobic	Living, active, or occurring in the presence of oxygen. Most biological activities require oxygen to produce energy.
Anaerobic	Living, active, or occurring in the absence of oxygen. Some bacteria function only in the absence of oxygen. This lack of oxygen causes formation of hydric soils and restricts the type of plant that can grow on a site.
Associated Wetlands	Wetlands with a continuous or intermittent connection to a water body.
Association	A group of plant species which tend to occur together, and are usually found in similar proportions.
Detritus	Broken down fragments of organic matter that result from disintegrating and decaying organisms.
Ecosystem	An interacting system of one to many living organisms and their physical environment.
Flooded	A condition in which the soil surface is temporarily covered with flowing water from any source, such as streams, runoff water or tides.
Gleying	A soil condition resulting from prolonged saturation and the resulting anaerobic, reducing state. Iron and manganese change chemical states, and these changes result in bluish, greenish or greyish colors.
Groundwater	Underground water supplies stored in aquifers. Groundwater is created and recharged by rain which soaks into the ground, then flows down until it is collected at a point where the ground is not permeable.
Habitat	An environment occupied by plants and animals which provides shelter, water, food, nesting or breeding.
Hydric	Something whose character is either influenced or determined by the presence of water.
Hydrophytic Plants	Those plants which are characteristically adapted to growth and reproduction in water or a substrate that is at least periodically deficient in oxygen as a result of excessive water content. Also referred to as hydrophytes.

Hydric Soil	Soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper layers.
Hydrology	The properties, distribution and circulation of water. Wetland hydrology is the total of all wetness characteristics in areas that are inundated or have saturated soils for a sufficient duration to support hydrophytic vegetation.
Indicator Status	Reflects the probability that a plant species will occur in wetlands.
Inundated	A condition in which a soil is periodically or permanently flooded or ponded by water.
Isolated Wetland	Isolated wetlands are those which are not hydrologically connected to a river, lake or stream.
Mineral Soil	A soil consisting mainly of, and having properties determined mostly by mineral material.
Mitigation	Avoiding, minimizing, rectifying, reducing or eliminating, compensating, and/or monitoring impacts.
Monotypic	Composed of only one species.
Mottling	Plotches of different colors interspersed with the primary color of a soil sample.
Nutrients	Essential chemicals needed by plants or animals for growth. Excessive amounts of nutrients can lead to degradation of water quality by promoting "blooms" of plant growth. The subsequent decaying process uses up the available oxygen in the water, which in turn kills fish and other organisms that require oxygen.
Organic Soil	Soil consisting mainly of organic or plant material, usually some type of peat or muck.
Parameter	A characteristic that can be defined or measured. Soils, vegetation, and aspects of hydrology are characteristics that can be defined or measured with respect to wetlands.
Periodic	Occurring or recurring at intervals which do not need to be regular or predictable.
Pollutant	A contaminant that adversely alters the physical, chemical, or biological properties of the environment. This includes pathogens, toxic substances, carcinogens, garbage, sewage, and all other harmful substances.
Saturated	A condition in which all pores between soil particles in the root zone are filled with water to a level at or near the soil surface.

Sediment	Material carried in suspension by flowing water which will ultimately settle to the bottom after the water loses velocity. Also the material deposited or accumulated on the bottom of waterways.
Soil	A dynamic natural body on the surface of the earth in which plants grow, composed of mineral and organic materials and living fungi, algae and microscopic organisms.
Species	A single, distinct kind of plant or animal, with distinguishing characteristics.
Storm Drain	A system of gutters, pipes, ditches, or connecting ponds used to carry stormwater from surrounding lands to streams, lakes or the ocean. These systems can also encompass naturally occurring wetlands.
Stormwater	Water that is generated by rainfall and is often routed into drain systems in order to prevent flooding. This water often carries oil, chemicals, antifreeze, and other pollutants from industrial and commercial runoff.
Treatment	Chemical, biological, or mechanical procedures applied to an industrial or municipal discharge or to other sources of contamination to remove, reduce, or neutralize contaminants.
Vegetation Unit	A group or association of plants that are similar in appearance, i.e., shrubs, grasses, deciduous trees. For this inventory, a vegetation unit was considered to be an apparent association of plants, with a consistent makeup, and with one or more species typically dominant. A grassy field, for instance, could be made up of more than one vegetation unit.

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APPENDIX A

WETLAND INVENTORY DATA FORM

Wetland No.: _____ Map No.: _____
 1/4__ 1/4__ S__ T__ R__ 1/4__ 1/4__ S__ T__ R__
 1/4__ 1/4__ S__ T__ R__ 1/4__ 1/4__ S__ T__ R__

Location: _____

Parcel No(s): _____

Date Inventoried: _____ Zoning: _____ Plan Map: _____

Weather Conditions: _____

A. HYDROLOGIC/SOIL FUNCTION

1. General wetland type or characteristic:

- | | |
|---------------------------------|----------------------|
| A. River _____ | E. Wet Pasture _____ |
| B. Stream _____ | F. Pond/Lake _____ |
| C. Marsh/Swamp/Bog _____ | G. Other _____ |
| D. Drainage Channel/Ditch _____ | |

2. Types of water bodies associated with the wetland (Inlet (I); Outlet (O); Undetermined (U)):

- | | |
|---------------------------------|--------------------------|
| A. River _____ I/O/U | E. Pond/Lake _____ I/O/U |
| B. Stream _____ I/O/U | F. None (Groundwater |
| C. Drainage Channel/Ditch I/O/U | Exchange) I/O/U |
| D. Drainage Pipe I/O/U | |

3. Distance to nearest drainage facility:

- | | | |
|--------------|---------------|---------------------|
| A. 0-100' | C. 500'-1000' | |
| B. 100'-500' | D. >1000' | N S E W NE SE NW SW |

4. Evidence of water movement through the wetland:

- A. No outlet.
- B. Outlet with standing water/water below outlet.
- C. No visible water movement (but water moving from outlet).
- D. Visible movement of water through wetland.
- E. None.

Comment: _____

5. Extent of pollutant discharge into the wetland.

- A. No known discharge.
- B. Probable discharge.
- C. Visible discharge.

Source: _____

6. The substrate is saturated with water or covered by shallow water at some time during the growing season of each year:

No Yes (Probable) Yes (Confirmed) ___ Inconclusive

7. Is there visible surface water?

No ___ Yes ___

8. Field evidence of inundation or saturation (i.e. water marks, drift lines, algal mats): _____

9. The substrate is predominantly undrained hydric soil:

No Yes ___ Field Inventory (See below)
___ Soil Conservation Service Maps

Test Pit #: _____

Series/Phase: _____

Is the soil on the hydric soil list? _____

Is the soil:

Mottled? No ___ Yes ___ Matrix Color _____

Gleyed? No ___ Yes ___ Gley Color _____

Saturated? No ___ Yes ___ Sulfur smell? No ___ Yes ___

Entisol with Mottling? No ___ Yes ___

Chroma ___ Hue ___ Value ___

Test Pit #: _____

Series/Phase: _____

Is the soil on the hydric soil list? _____

Is the soil:

Mottled? No ___ Yes ___ Matrix Color _____

Gleyed? No ___ Yes ___ Gley Color _____

Saturated? No ___ Yes ___ Sulfur smell? No ___ Yes ___

Entisol with Mottling? No ___ Yes ___

Chroma ___ Hue ___ Value ___

=====

NOTES:

B. BIOLOGICAL FUNCTION

Wetland No. _____

Map No. _____

1. At least periodically, the land supports predominantly hydrophytes:

No Yes* (Probable) Yes* (Confirmed) ____ Inconclusive*

*See attached worksheets.

2. Degree of hydrophytic vegetation cover on the wetland (See attached worksheets):

A. >75% B. 50-75% C. 25-50% D. 0-25%

3. Agricultural use is present within the wetland:

No

Yes (Extent of Coverage): A. 0-25% B. 25-50%
C. 50-75% D. >75%

4. Quality of wetland for breeding/spawning, wintering/transit or habitat for anadromous fish, trout, game fish, game birds or other mammals of significant commercial or recreational value (see attached plant list):

A. Breeding Area	No	Yes(Probable)	Yes(Confirmed)
B. Spawning Area	No	Yes(Probable)	Yes(Confirmed)
C. Wintering/Transit	No	Yes(Probable)	Yes(Confirmed)
D. Habitat	No	Yes(Probable)	Yes(Confirmed)
E. Rare/Endangered Species*	No	Yes(Probable)	Yes(Confirmed)

*Based on U.S. Department of Interior Fish and Wildlife Service and the Washington State Departments of Wildlife, and Natural Resources reporting.

Observation:

5. Surrounding habitat:

A. Open Water:	N	S	E	W	NE	SE	NW	SW
B. Agricultural	N	S	E	W	NE	SE	NW	SW
C. Grass:	N	S	E	W	NE	SE	NW	SW
D. Wooded:	N	S	E	W	NE	SE	NW	SW
E. Brush/shrub:	N	S	E	W	NE	SE	NW	SW
F. Developed/Urban:	N	S	E	W	NE	SE	NW	SW
G. Filled/unvegetated:	N	S	E	W	NE	SE	NW	SW
H. Freeway/Railroad:	N	S	E	W	NE	SE	NW	SW

6. Special habitat features:

- A. Snags >25' high
- B. Snags <25' high
- C. Rock outcrop
- D. Perches

- E. Logs
- F. Canopy cover
- G. Other _____
- H. None.

7. Animals observed on the wetland site:

Birds

Fish/Amphibians/Reptiles

Mammals

Other Species

=====

NOTES:

C. VISUAL/CULTURAL FUNCTION

Wetland No. _____

Map No. _____

1. Size of wetland:

Average Width: _____ feet. N/S E/W
Average Length: _____ feet. N/S E/W
Estimated Area: _____ acres

2. Distance in miles to nearest school:

A. 0-.5 miles: N S E W NE SE NW SW
B. .5-1 miles: N S E W NE SE NW SW
C. 1-2 miles: N S E W NE SE NW SW
D. >2 miles: N S E W NE SE NW SW

3. Distance in miles to nearest park:

A. 0-.5 miles: N S E W NE SE NW SW
B. .5-1 miles: N S E W NE SE NW SW
C. 1-2 miles: N S E W NE SE NW SW
D. >2 miles: N S E W NE SE NW SW

4. Types of access to the wetland:

A. Pedestrian Trail: N S E W NE SE NW SW
B. Bicycle Trail: N S E W NE SE NW SW
C. Road: N S E W NE SE NW SW
D. Boatable Watercourse: N S E W NE SE NW SW
E. None.

5. Types of access within the wetland:

A. Pedestrian Trail
B. Bicycle Trail
C. Road
D. Boatable Watercourse
E. None.

6. Surrounding land uses:

A. Vacant: N S E W NE SE NW SW
B. Agricultural : N S E W NE SE NW SW
C. Industrial/commercial: N S E W NE SE NW SW
D. Residential: N S E W NE SE NW SW
E. Park Land: N S E W NE SE NW SW
F. Freeway/Railroad R/W: N S E W NE SE NW SW

=====

NOTES:

D. FISH AND WILDLIFE SERVICE CLASSIFICATION

Wetland No. _____

Map No. _____

I. System _____
Subsystem _____
1. Class _____ % Cover _____
 Subclass _____
 Subclass _____
 Subclass _____
 Modifier _____
2. Class _____ % Cover _____
 Subclass _____
 Subclass _____
 Subclass _____
 Modifier _____
3. Class _____ % Cover _____
 Subclass _____
 Subclass _____
 Subclass _____
 Modifier _____
4. Class _____ % Cover _____
 Subclass _____
 Subclass _____
 Subclass _____
 Modifier _____
5. Class _____ % Cover _____
 Subclass _____
 Subclass _____
 Subclass _____
 Modifier _____

=====

NOTES:

E. SUMMARY

Wetland No. _____

Map No. _____

1. Is wetland hydrology present?

___No ___Yes (Probable) ___Yes (Confirmed) ___Inconclusive

2. Is hydric soil present?

___No ___Yes

3. Is a predominance of wetland vegetation present?

___No ___Yes (Probable) ___Yes (Confirmed) ___Inconclusive

4. The wetland is classified as:

___ Non-wetland

___ Fish and Wildlife Service

___ U.S. Army Corps of Engineers

=====

NOTES:

F. WETLAND SURVEY

The following map indicates such features as the general wetland shape, location of survey transects, wetland dimensions, public access, and the location of specific survey information (i.e. soil test pits; inlets; outlets; habitat features; etc.):

VEGETATION UNIT WORKSHEET

Wetland No. _____

Map No. _____

VEGETATIVE

UNIT

SPECIES

INDSTAT

%COVER

COVER

STATUS

Vegetation unit community indicator status:_____

Proportion of vegetation unit to the entire wetland: _____%

Do the dominant species indicate that the vegetation unit supports hydrophytic vegetation? No___ Yes___ Inconclusive___

APPENDIX B:
MILL CREEK INVENTORY PLANTS

<u>Scientific Name</u>	<u>Common Name</u>	<u>Indicator</u>
Acer circinatum	Vine maple	FACU+
Acer macrophyllum	Big-leaf maple	FACU
Agropyron repens	Quack grass	FACU
Agrostis alba	Redtop	FACW
Agrostis exarata	Spike bentgrass	FACW
Agrostis tenuis	Colonial bentgrass	UPL
Alnus rubra	Red alder	FAC
Alopecurus geniculatus	Meadow foxtail	FACW+
Alopecurus pratensis	Meadow foxtail	FACW
Amaranthus retroflexus	Redroot pigweed	FACU+
Anthemis cotula	Stinking mayweed	FACU
Aster subspicatus	Douglas' aster	FACW
Athyrium filix-femina	Lady fern	FAC
Bidens cernua	Nodding beggar's tick	FACW+
Bidens frondosa	Devil's beggar's tick	FACW+
Carex amplifolia	Big-leaf sedge	FACW+
Carex obnupta	Slough sedge	OBL
Carex rostrata	Beaked sedge	OBL
Carex stipata	Saw beaked sedge	OBL
Cirsium arvense	Canada thistle	FACU+
Cirsium vulgare	Bull thistle	FACU
Cornus stolonifera	Red-osier dogwood	FACW
Crepis setosa	Rough hawksbeard	UPL
Cynosurus cristatus	Dogtail	UPL
Cyperus esculentus	Chufa	FACW
Cytisus scoparius	Scotch broom	UPL
Dactylis glomerata	Orchard grass	FACU
Echinochloa crusgalli	Barnyard grass	FACW
Eleocharis palustris	Creeping spikerush	OBL
Eleocharis parvula	Small spikerush	OBL
Epilobium ciliatum	Hairy willow-herb	FACW-
Equisetum arvense	Field horsetail	FAC
Festuca arundinacea	Kentucky fescue	FACU-
Festuca pratensis	Meadow fescue	FACU+
Festuca rubra	Red fescue	FAC
Fraxinus latifolia	Oregon ash	FACW
Galium aparine	Catchweed bedstraw	FACU
Geranium molle	Dovefoot geranium	UPL
Glyceria borealis	Small floating manna grass	OBL
Glyceria elata	Tall manna grass	FACW+
Gnaphalium palustre	Western marsh cudweed	FAC+
Holcus lanatus	Common velvet grass	FAC
Holcus mollis	Creeping softgrass	UPL
Iris pseudacorus	Yellow iris	OBL
Juncus acuminatus	Taper-tip rush	OBL
Juncus balticus	Baltic rush	OBL
Juncus bufonius	Toad rush	FACW+
Juncus effusus	Soft rush	FACW+

<i>Juncus ensifolius</i>	Dagger leaf rush	FACW
<i>Lactuca serriola</i>	Prickly lettuce	FAC-
<i>Leersia oryzoides</i>	Rice cutgrass	OBL
<i>Lemna minor</i>	Duckweed	OBL
<i>Lolium multiflora</i>	Annual ryegrass	UPL
<i>Lolium perenne</i>	Perennial ryegrass	FACU
<i>Lotus corniculatus</i>	Bird's foot trefoil	FAC
<i>Lysichitum americanum</i>	Skunk cabbage	OBL
<i>Lythrum salicaria</i>	Purple loosestrife	OBL
<i>Mimulus guttatus</i>	Common monkey flower	OBL
<i>Nasturtium officinale</i>	Watercress	OBL
<i>Nymphaea odorata</i>	Water lily	OBL
<i>Oenanthe sarmentosa</i>	Water parsley	OBL
<i>Oplopanax horridum</i>	Devil's club	FAC
<i>Panicum capillare</i>	Witchgrass	FAC
<i>Parentucellia viscosa</i>	Yellow parentucellia	FAC-
<i>Phalaris arundinacea</i>	Reed canary grass	FACW
<i>Phleum pratense</i>	Timothy	FACU
<i>Plantago lanceolata</i>	English plantain	FACU+
<i>Plantago major</i>	Common plantain	FAC+
<i>Poa annua</i>	Annual bluegrass	FAC-
<i>Poa compressa</i>	Canada bluegrass	FACU
<i>Polygonum californicum</i>	California knotweed	UPL
<i>Polygonum hydropiperoides</i>	Swamp Smartweed	OBL
<i>Polygonum persicaria</i>	Lady's thumb	FACW
<i>Polypodium glycyrrhiza</i>	Licorice fern	UPL
<i>Populus balsamifera</i>	Black cottonwood	FAC
<i>Potentilla anserina</i>	Silverweed	OBL
<i>Ranunculus acris</i>	Tall buttercup	FACW-
<i>Ranunculus repens</i>	Creeping buttercup	FACW
<i>Rorippa curvisiliqua</i>	Yellow cress	FACW+
<i>Rubus discolor</i>	Himalayan blackberry	FACU-
<i>Rubus laciniatus</i>	cut leaf blackberry	FACU+
<i>Rubus parviflorus</i>	Thimbleberry	FACU+
<i>Rubus spectabilis</i>	Salmonberry	FAC
<i>Rumex crispus</i>	Curly dock	FACW
<i>Salix spp.</i>	Willow	FACW
<i>Sambucus racemosa</i>	Red elderberry	FACU
<i>Scirpus acutus</i>	Hard-stem bullrush	OBL
<i>Scirpus microcarpus</i>	Small-fruited bullrush	OBL
<i>Senecio jacobea</i>	Tansy ragwort	UPL
<i>Smilacina stellata</i>	False solomon's seal	FAC-
<i>Solanum dulcamara</i>	Climbing nightshade	FAC
<i>Sparganium emersum</i>	Narrow-leaf burreed	OBL
<i>Spirea douglasii</i>	Hardhack	FACW
<i>Stellaria media</i>	Chickweed	UPL
<i>Tanacetum vulgare</i>	Tansy	UPL
<i>Taraxacum officinale</i>	Dandelion	FACU
<i>Thuja plicata</i>	Western red cedar	FAC
<i>Trifolium pratense</i>	Red clover	FACU
<i>Trifolium repens</i>	White clover	FACU+
<i>Typha latifolia</i>	Broadleaf cattail	OBL
<i>Urtica dioica</i>	Stinging nettle	FAC+
<i>Veronica americana</i>	American speedwell	OBL

APPENDIX C:
SOILS IN MILL CREEK
INVENTORY AREA

ENTISOLS

Aquents

(Br)	Briscott
(Os)	Oridia
(Re)	Renton
(So)	Snohomish
(Wo)	Woodinville
(Pk)	Pilchuck

INCEPTISOLS

Aquepts

(No)	Norma
(Pu)	Puget

MOLLISOLS

Xerolls

(Py)	Puyallup
------	----------

HISTOSOLS

Hemists

(Sk)	Seattle
------	---------

